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RAILROAD SIGNAL GLASSWARE

The railroad signal engineers of America have been pioneers both in the demand for the best available signal glassware and in the formulation of purchase specifications which would insure compliance with that demand. The most recent specifications formulated for signal glassware are designated as Association of American Railroads (AAR) Signal Section Specifications 59–38 and 69–38, dealing respectively with lantern glassware and with pressware, disks, and slides. The Bureau has cooperated with the AAR Signal Section and with Corning Glass Works in the extensive measurements leading to the formulation of these latest specifications. This cooperative work has been in progress since 1930.

The June number of the Journal of Research contains a paper (RP1209) by K. S. Gibson and G. W. Haupt that is the first of a series describing this investigation, although several reports on the work have already been issued to the signal engineers. This paper gives the spectral transmissions of the basic standards—red, yellow, green, blue, purple, and lunar-white glasses—on which the AAR scale of transmission is based. Comparison is made with the scales defined in the 1908 and 1918 signal-glass specifications. Future papers will deal with the measurement and specification of the glasses selected to define the limits of permissible color when used with specified illuminants.

RESOLVING POWER AND DISTORTION OF AIRPLANE-CAMERA LENSES

The precision lens-testing camera developed in the Bureau's optical instruments section has proved particularly useful in testing of airplane-camera lenses, where the measurements most commonly desired are focal lengths, distortion, and resolution. In the course of these measurements, it has been

[1] Published with approval of the Director of the Budget.

found that the manner in which the resolving power of a given lens varies across the image plane is characteristic of the type of lens. The results also show that the practice of setting a lens in a camera so that the region of best imagery is at the center of the field does not always yield best average resolving power across the entire field. The distortions of lenses used in airplane cameras, on comparison with distortion measurements published a decade ago, are shown to have been reduced in that time.

A paper (RP1216) by F. E. Washer in the June number of the Journal of Research contains tabulations of the resolving power and distortion of lenses of three different types. A complete description of the process of selecting the image plane that gives best average definition is also given.

MICROSCOPIC METHODS FOR IDENTIFYING COMMERCIAL FIBERS

Many things which are in daily use, such as paper, clothes, and furniture, are made wholly or to a considerable extent from fibers. These fibers may be obtained from plants (cotton), from animals (silk), from minerals (asbestos); or they may be synthetic fibers (rayon). Furthermore, some of these fibers are treated in various ways during the process of manufacture (thus pulp for writing paper is sometimes bleached). Frequently the suitability of a finished product for a certain purpose depends on the kind of fiber which has been used and how it has been treated.

To purchase things economically and satisfactorily it is necessary to know what you are buying, and it is to find this out that articles are tested. The examination of fibers by means of the microscope is often a quick and sure way of analyzing a material; moreover, the sample needed for such an examination is very small, a desirable feature since materials are usually destroyed during analysis.

A compilation of about fifty methods for testing materials by microscopic means was made recently by T. M. Plitt, formerly a member of the staff of the Bureau's textile section, and now with the Department of Agriculture. These methods, which are described in Circular C423, released a short time ago, include means of identifying the following fibers: Cotton, mercerized cotton, flax, wool, casein fiber, silk, "wild" silk, the different rayons, ramie sisal, jute, coconut, and abacá. Methods are also given for distinguishing ground wood, coniferous and deciduous wood pulps, sulfite and sulfate wood pulps, and bleached fibers; also for detecting used cotton and damaged wool.

Copies of C423 are obtainable from the Superintendent of Documents, Government Printing Office, Washington, D. C. at 10 cents each.

ESTIMATION OF CYSTINE BY THE DROPPING MERCURY CATHODE

Cystine is a naturally occurring sulfur-containing amino acid of considerable biological importance. It is a constituent of such protein materials as hair, fingernails, wool, and insulin. Its determination by means of the polarograph (an instrument for the automatic recording of current-voltage curves) is discussed in RP1211 by E. R. Smith and C. J. Rodden in the Journal of Research for June. It is shown that the determination depends on the assumption that other substances ordinarily present in the protein materials investigated do not produce interfering waves on the current-voltage curve.

The reduction maximum of cysteine at the dropping mercury cathode, in a buffered solution containing bivalent cobalt, is not affected by methionine or benzylcysteine at concentrations up to somewhat more than twice that of the cysteine. Djenkolic acid reduces the height of this maximum without changing its form or position. By themselves, methionine, benzylcysteine, and djenkolic acid show no reduction wave between 0.8 and 2.1 volts.

BUBBLER TIP FOR DIFFICULT ABSORPTIONS

RP1214 by J. R. Branham and E. O. Sperling in the June Journal of Research describes a tip made of Pyrex glass to be used in a gas-absorption pipette to divide the stream of gas into small bubbles in order to obtain a large surface of contact with liquid reagents. The tip is made by sealing a number of fine copper wires, radiating from a center in a definite pattern, between a cone formed on the end of a glass tube and a circular glass disk. After the glass parts are sealed together and ground to expose the ends of the wires, the wires are dissolved in warm nitric acid. Drawings which illustrate the method of making the tips are included. The tips are very sturdy and at moderate pressures furnish small bubbles of uniform size and distribution.

DETERMINATION OF COPPER AND LEAD IN NITRIC ACID SOLUTION

In the analysis of copper-base alloys, for example, brasses and bronzes, copper is usually determined by electrolytic deposition of the metal from an electrolyte containing sulfuric and nitric acids. If the deposition of copper is made in nitric acid solutions, difficulties are encountered in consistently obtaining quantitative deposition, unless the nitric acid solution of the alloy is either fumed with sulfuric acid or evaporated to dryness and baked moderately. These operations require additional time, and a search was made by J. A. Scherrer, R. K. Bell, and W. D. Mogerman at the Bureau to see if they could be eliminated. As explained in RP1213 in the June Journal of Research, it was found that complete deposition of copper is obtained if a small amount of hydrochloric acid (1 drop of 0.1 *N* solution) is added to the nitric acid solution, either during the solution of the alloy, or at the beginning of the electrolysis.

MEETING OF METALLURGICAL ADVISORY COMMITTEE

The twenty-fourth meeting of the Bureau's Metallurgical Advisory Committee was held on May 9, with 34 members in attendance. The first meeting of the committee was held April 14, 1914. Originally only problems in nonferrous metallurgy were dealt with. Later a ferrous committee was organized, and some time afterward the two committees were combined. Meetings are now held alternately in the spring and fall at intervals of 1½ years; that is, the next will take place in the fall of 1940.

The committee is composed of representatives appointed by the principal metallurgical technical societies, plus several "members at large" who are prominent specialists in certain fields. The chairman is G. B. Waterhouse, professor of metallurgy, Massachusetts Institute of Technology. The object of the committee is to advise the Bureau on technical methods of conducting its researches and to offer suggestions concerning the practical value of contemplated projects. In addition to the committee members, the chairmen of all ASTM committees dealing with metals were invited to attend as guests.

The following projects were presented for discussion: Copper-base ingot metals, "85–5–5–5," by H. B. Gardner; Elastic properties of cast iron, by C. M. Saeger and A. I. Krynitsky; Foundry sands, by C. M. Saeger and H. E. Francis; "Elemental" iron, by H. E. Cleaves; Refractories for use in melting high-purity metals, by J. G. Thompson; "Gases" in metals, by V. C. F. Holm; Plastic deformation of metals, by H. C. Vacher and H. K. Herschman; Pipe corrosion, by T. D. Brown; Water-treatment to retard corrosion of steel, by J. H. Wilson; Weathering of aircraft sheet metals, by W. H. Mutchler; Treatments for improving the permanence of magnesium alloys, by R. W. Buzzard; Roofing materials, by L. J. Waldron; Painting of steel to be used in building construction, by R. E. Pollard; Silver Research Project, by A. J. Dornblatt; High-temperature creep of metals, by J. A. Bennett; Low-temperature properties of aircraft structural metals—impact resistance, by S. J. Rosenberg; Thermal transformations in steel and grain size, by S. J. Rosenberg; Quality of carbon steels, by T. G. Digges; Weather exposure of aircraft sheet metals, by W. H. Mutchler; Accelerated testing to determine susceptibility of aluminum alloys to intercrystalline corrosion, by H. L. Logan; Does continued fatigue-stressing of a steel below its endurance limit seriously affect the metal? by J. A. Kies; Significance of a ductility requirement in specifications for metals, by G. F. Wohlgemuth; Study of torsion-impact test, by G. W. Quick; Soldered joints in copper tube plumbing, by A. R. Maupin; Improved metallographic technique, by G. A. Ellinger; Fatigue of chromium-plated steel, by R. D. France; New microhardness tests, by C. G. Peters and F. Knoop; Oxide coloring of steels, by G. W. Geil; Elastic properties of high-strength aircraft structural metals, by R. W. Mebs; and Standard chemical analytical samples, by G. E. F. Lundell and H. A. Bright.

Of these projects, two were of unusual interest to the committee. One of these, the first on the above list, was the cooperative study which the Bureau has made with the Non-Ferrous Ingot Metal Institute. It is described in a succeeding item. The second (the twenty-first on the list) was in the nature of an answer to a question of great moment in the field of aeronautics, that is, the effect of continued fatigue stressing of steel below its endurance limit. So far, work on a typical aluminum alloy, which has been conducted in cooperation with the National Advisory Committee for Aeronautics, has shown no detectable deleterious change, at least at room temperature. However, ac-

cording to present indications, it may be necessary to expand the scope of this project to meet the needs of other Federal aircraft agencies.

Copies of the discussions at the meeting are not available from the Bureau.

INDUSTRIAL USES FOR SILVER

As noted in Technical News Bulletin 265, the American Silver Producers' Research Project has been extended for another year, terminating May 31, 1940.

It has been decided to concentrate attention during this final year of the project on work relating to commercialization of silver-lined containers, silver alloys, electrical brushes, fungicides containing silver, and corrosion studies. The research work connected with the container and alloy programs is concentrated at the Bureau where the staff now consists of nine research associates[2] with a part-time helper and a research clerk. The work of this staff is about equally divided between electroplating studies and alloy research. A silver-plating plant has been set up and will be used to prepare material for fabrication by commercial organizations which are cooperating with the project in its effort to develop silver-lined containers.

The research on fungicidal properties of silver is being carried on at Cornell University by L. W. Nielsen under the direction of L. M. Massey; that on brushes is under the supervision of S. B. Wiltse at Rensselaer Polytechnic Institute; and the research on corrosion resistance of silver is in progress at Lehigh University, where J. M. Thomas is working under the direction of Allison Butts.

DEVELOPMENT OF FIBROUS TEXTURE IN COLD-WORKED COPPER RODS

A recently completed investigation by H. C. Vacher, of the Bureau's Metallurgical Division, has indicated how the fibrous texture of copper rods is developed. A fibrous texture is obtained whenever a polycrystalline rod is cold-worked by processes such as drawing or swaging. This kind of structure in cold-worked rods of copper consists of crystals oriented with an octahedral axis or a cubic axis parallel to the rod axis. Other axes of the crystals are oriented randomly in respect to a direction perpendicular to the rod axis. A metallographic examination shows that the original crystals have been elongated into thread-like fibers. This suggests that each fiber might have remained a single crystal during the cold-working process. Then the fibrous texture in copper rods could be developed by each crystal changing its initial orientation to one of the two stable orientations, that is, with an octahedral axis or a cubic axis parallel to the rod axis. In order to show the truth of this, experimentally, the changes in individual crystals resulting from different degrees of swaging were determined. The small size of the crystals makes its impossible to determine these changes in the crystals of copper rods available commercially. However, by making monocrystalline and bicrystalline rods of suitable size this difficulty was overcome. A bicrystalline rod in this case is a rod whose cross section shows two crystals at any location along its length.

The results, as given in the Journal of Research for June (RP1210), show that a crystal which attained the cubic orientation deformed as a single crystal to a 95-percent reduction in area. However, a crystal that approaches the octahedral orientation is converted partly into secondary crystals at a reduction of approximately 60 percent. The secondary crystals change their orientations so that the cubic orientation is attained. The remaining portion of the original crystal attains the octahedral orientation. These results were obtained from bicrystalline rods as well as from monocrystalline rods. This indicates that the changes taking place in individual crystals are independent of the boundaries of crystals and consequently independent of their initial size and shape. Therefore, the observed changes in the monocrystalline and bicrystalline rods are applicable to the crystals in copper rods available commercially.

EFFECTS OF ALUMINUM AND OF ANTIMONY ON CAST RED BRASS

The effects of aluminum and antimony, added individually to the red brass alloy, made of remelted metal, of the nominal composition 85 percent of copper and 5 percent each of tin, zinc, and lead, have been studied by H. B. Gardner and C. M. Saeger, Jr., at the Bureau, as part of an investigation sponsored since 1930 by the Non-Ferrous Ingot Metal Institute. The major purpose of this investigation is the collection of data to be used in the simpli-

[2] A. J. Dornblatt, A. M. Setapen, A. C. Simon, C. J. Le Brasse, C. W. Pimper, J. T. Lumley, and G. G. Luther.

fication of the number of compositions now in commercial use.

Additions of aluminum from 0.005 to 0.10 percent, and of antimony from 0.10 to 0.25 percent were made to the alloy cast at pouring temperatures of 1,065° C. (1,950° F.), 1,150° C. (2,100° F.), and 1,230° C. (2,250° F.) Tensile properties, electrical resistivity, density, Brinel hardness, the running quality of the alloy, and its ability to withstand hydraulic pressure were determined on various types of test specimens.

The data obtained, which are set forth in detail in the Journal of Research for June (RP 1215) show that:

1. The influence of pouring temperature was subordinate to that of the added elements.

2. Aluminum had a detrimental influence on all of the properties studied except the running property.

3. Antimony had merely a nominal effect on all of the properties except the electrical resistivity, which was slightly increased, and the running property, which was increased to a greater degree.

4. Contamination of the alloy with the higher percentages of aluminum produced microstructural imperfections which were not visible in the aluminum-free alloy. The inferior results obtained for ductility and electrical resistivity, and the failure of the aluminum-treated alloy to withstand hydrostatic pressure were thought to be associated with local concentrations of these imperfections at dendrite interstices. The data obtained seemed to warrant the conclusions that the present restriction of the aluminum content to 0.005 percent of aluminum in ASTM Specification B 30–36 is justified and that antimony up to 0.25 percent (maximum now permitted in that specification) does not have a deleterious effect on the alloy.

CRUCIBLES FOR MELTING METALS

The preparation of metals of as high a degree of purity as possible is an important line of laboratory work in the Bureau's Division of Metallurgy. The nature of the crucible used in this work is of fundamental importance, since contamination may readily occur if it is made of improper material. Suitable crucibles are not often available commercially but must be made in the laboratory for each particular project. Recently J. G. Thompson has used the slip-casting method in preparing crucibles from a number of the refractory oxides. Magnesia crucibles, which are very desirable for certain lines of work, could not hitherto be made by "slip casting." The method was modified, however, and by carrying out the procedure in *absolute* alcohol excellent results have been obtained. This development is an entirely new one. By the slip-casting method thin-walled crucibles of nearly any shape desired in laboratory work can be obtained which, when fired after drying, possess exceptionally high mechanical strength, hardness, and resistance to "thermal shock." The ability to produce crucibles of this general excellence greatly facilitates one of the important projects under way in the Division—the production of *pure* iron.

THE "PACK" METHOD FOR COMPRESSIVE TESTS OF THIN-WALL MATERIALS

The strength of modern light-weight thin-wall structures, such as airplane wings and fuselages, is generally limited by the strength of the compression members. These have frequently been designed on the basis of the tensile properties of the material. This is convenient, as the tensile test is relatively simple and is widely used. However, it may lead to an unsafe structure on the one hand or an uneconomical structure on the other if the compressive properties of the material differ from the tensile properties.

The "pack" test, developed by C. S. Aitchison and L. B. Tuckerman at the Bureau, with the support of the National Advisory Committee for Aeronautics, makes possible a direct determination of compressive stress-strain graphs for thin-wall material. Lateral stability is obtained by assembling a number of specimens into a pack, like a "pack of cards," and by the use of lateral supports between the external sheet faces of the pack and outside reactions. Studies have been made of the effectiveness of the external support and the reproducibility of the test results by testing packs taken from sheets (ranging in thickness from 0.032 to 0.120 inch) of aluminum alloy 17ST, carbon, and chromium-molybdenum steel. These tests included 10 groups of packs with at least 2 packs for each group. The largest spread in yield strength, obtained from the primitive stress-strain graphs, was about 2 percent.

The "pack" test is based on the assumption that it will give compressive results like those obtained from block compressive tests. A number of comparative tests on packs and on compact solid specimens taken from metal bars

were made to see whether or not this assumption was justified. The results of these tests indicate that the method of transverse support has no appreciable effect on the yield strengths. The largest difference in yield strength between a pack and a solid specimen was 1.60 percent. Experience has shown that packs composed of 13 specimens of 0.032-inch aluminum alloy and 5 specimens of 0.05-inch heat-treated chromium-molybdenum steel will sustain compressive stresses in excess of 60 and 180 kips/in.^{2}, respectively, before the packs fail through major instability. Experience gathered in developing this test emphasizes the fact that, although the test seems to furnish results within the same order of accuracy as are usually obtained from other mechanical tests, such as the tensile test, it will have to be simplified before it can be used economically for inspection testing. The test seems adequate, however, for many problems in structural research.

The complete account of this work has been published by the National Advisory Committee for Aeronautics as Report 469. Copies are obtainable from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 10 cents each.

SOUND INSULATION OF WALLS AND FLOORS

Building Materials and Structures Report BMS17, recently released, contains a general discussion of the Bureau's work on sound insulation. The factors which control the transmission through homogenous and nonhomogeneous walls are discussed.

A homogeneous wall which would give a high degree of sound insulation would have to be excessively heavy. Therefore, where sound insulation is desired, it is necessary to build nonhomogeneous structures. The ideal structure for a sound insulated room is a box within a box without any connecting ties between. Although this is impossible, an approximation to it can be made by the use of special supports at as few points as possible.

The effect of openings is discussed; and it is shown that a very small opening, such as the crack under a door, will almost completely destroy the sound insulating value of any wall.

Masking effects are discussed, and attention is called to the fact that only a small amount of general noise makes a wall appear to be a much better sound insulator than it really is.

Attention is called to the fact that where quiet conditions are required within the building, care should be taken to pick a locality for the building where the noise level is not excessively high. Also, when it is desirable that some rooms should be quieter than others, they should be placed where there will be the least disturbance from normal noises which occur in the building.

The report summarizes the data on the construction of many of the panels which have been tested at the Bureau, and their corresponding sound insulating properties.

Copies of BMS17 are obtainable from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 10 cents each.

ALLOYS FOR ELECTRIC HEATING ELEMENTS

The manufacturers of electric heating devices, from toasters to furnaces, as well as the users of these devices, have always been vitally interested in the life and maximum operating temperature of the heating unit. Various types of tests, such as the "Accelerated Life Test for Metallic Materials for Electrical Heating" B 76–38 of the American Society for Testing Materials, have been devised with the view of predicting the life expectancy of a heating element under specified conditions of operation. The operating temperature of the material probably has more effect upon the results obtained from these tests than any other single variable which must be controlled. Most tests of this nature are conducted by heating the materials electrically, and in such cases the temperature of the materials (usually in the form of small wires) is most conveniently measured with an optical pyrometer. The temperature observed when an optical pyrometer is sighted upon the surface of a material heated in this way, is known as the apparent temperature. In order to obtain the true temperature which determines the life of the material, some knowledge of the radiating characteristics of the surface is required.

A paper presented before the American Society for Testing Materials by W. F. Roeser of the Bureau's pyrometry section gives the relation between apparent temperature and true temperature of the various types of heating-element materials used in this country. When samples of the different types of materials were heated to the same apparent temperature of 2,200° F. in air, the true temperatures of the different materials ranged from 2,221° to 2,253° F. Although the difference between

2,221° and 2,253° F. is not large, the information available indicates that the life of an element in air may be changed by 25 to 50 percent by changing the temperature of the material 25° F.

When these same materials were operated at the same apparent temperature of 2,200° F. in purified hydrogen, the true temperature of the different materials ranged from 2,260° to 2,402° F. Results on some of the alloys in commercial hydrogen and nitrogen are also included.

This paper gives data needed to devise tests for determining the relative performance of different types of materials, not only in air, but also in atmospheres which are generally considered reducing.

ENERGY LOSSES IN AIR CAPACITORS

In the manufacture of cables for the transmission of electric power, paper impregnated with oil is an important insulating material. It is desirable that the oil have superior electrical-insulating properties in order to minimize power losses in the cables. Recent improvements in refining these cable oils have yielded products which, when tested by ordinary methods, appeared to give up electrical energy rather than absorb it. In other words, the power factor of such oil, which is a measure of its rate of absorbing electrical energy, appeared to be negative. In the Journal of Research for June (RP 1212), A. V. Astin describes an examination of the method of measuring the power factor of the oil which showed that it was not negative, but simply less than the power factor of an air capacitor which was used as a reference and assumed to have zero power factor.

Although ordinary air capacitors have appreciable power factors, attributed to the insulating supports necessary for their construction, it is possible to build special capacitors having three electrodes in which the effect of the insulating material on the power factor is eliminated. Such capacitors, which may be called guard-electrode capacitors, have been commonly assumed to have a zero power factor because of the elimination of the energy losses in the insulating supports. It has been found, however, that guard-electrode capacitors may have measurable power factors; and when this fact is taken into consideration, reasonable results are obtained for the power factors of high-grade cable oils.

The present paper deals with the nature of the energy losses in guard-electrode air capacitors. Their power factors have been found to be due to a layer of oxide or moisture, or both, on the surfaces of the electrodes. Comparative measurements have been made for a number of electrode materials under a wide range of operating conditions. Of the 10 metals tested—namely, aluminum; brass; monel metal; nickel; stainless steel; and chromium-plated, gold-plated, nickel-plated, rhodium-plated, and silver-plated brass—it was found that capacitors with aluminum electrodes had the largest power factors and silver-plated electrodes the smallest.

By careful measurements on ordinary two-electrode air capacitors it was possible to find evidence of energy losses in the surface layer superposed on the major loss in the insulating supports.

EDGE CORRECTION IN DETERMINATION OF DIELECTRIC CONSTANT

One of the properties of an electrical-insulating material is its dielectric constant. As the importance of this property is now realized in many branches of electrical engineering, the demand for accurate methods of measuring dielectric constants is increasing, particularly for materials in the form of sheets. In order to obtain accurate results, it is necessary to use a guard-ring arrangement of electrodes or to apply an edge correction to the simple formula that in the past has been generally employed.

The guard-ring method produces a uniform electric field between the measuring electrodes and is, therefore, accurate and simple. However, it is not always possible or practical to use this system for sheet-dielectric materials. In this event a correction must be applied to the usual simple equation, and the amount of the correction depends on the arrangement of the electrodes. In the Journal of Research for June (RP1217) H. L. Curtis and A. H. Scott derive theoretical equations for determining these corrections for certain arrangements of circular and rectangular electrodes. The accuracies of the methods were tested by making measurements on specimens having dielectric constants ranging from 2.5 to 70. Assuming the guard-ring values to be correct, the errors in the other methods were determined. Most of the methods gave values which were in error by more than 1 percent, some errors being as high as 7 percent for the

circular electrodes and 14 percent for the rectangular electrodes.

Empirical equations were set up which gave values that were in error by less than 1 percent for all electrode arrangements. These equations give a number of alternative methods for determining the dielectric constant with an accuracy better than the reproducibility of most dielectric materials.

JOINT MEETING INTERNATIONAL SCIENTIFIC RADIO UNION AND INSTITUTE OF RADIO ENGINEERS

The annual joint meeting of the American section of the International Scientific Radio Union and the Institute of Radio Engineers was held at the National Academy of Sciences in Washington on April 28 and 29. Twenty-five papers were presented in the field of radio science.

Four of the papers were presented by members of the Bureau's staff, as follows:

Comparison of long-distance broadcast transmissions over different paths, by S. S. Kirby and F. R. Gracely. Night field-intensity measurements of broadcast transmissions from Europe and South America have been made at the Bureau during the past five winters. These measurements show the South American transmissions to be much superior to those from Europe, both from the standpoint of average field intensity and night-to-night variations. The European transmissions were greatly weakened by ionosphere storms, however minor. The effect of each storm persisted for several nights.

A precision radio instrument and method for studying the distribution of ozone in the stratosphere, by R. Stair and W. W. Coblentz. The instrument consists of a photoelectric cell, a balanced amplifier, a relaxation oscillator, and a radio transmitter. A check on the calibration of the instrument is automatically made and broadcast to the receiving station each time an altitude signal is given. The instrument, with accessories, including sufficient batteries to operate for about 4 hours, weighs approximately 5 pounds. The amount of ozone above the instrument is calculated from the observed sunlight transmissions of optical filters as the instrument reaches different levels within the stratosphere. This calculation is based entirely upon observed values of the solar spectral-energy curve, the spectral transmissions of the filters, the spectral-response curve of the photo-electric cells, and the spectral absorption of ozone, after due correction is made for Rayleigh scattering.

Ionosphere disturbances, 1937–1938, by J. H. Dellinger. During this 2-year period the characteristics of three distinct types of ionosphere disturbances have been identified and data upon their occurrence compiled. The three types are: Sudden disturbances of the ionosphere; prolonged periods of low-layer absorption; and ionosphere storms. Comprehensive data on the first type, through 1936, have been published by the author. The present paper shows that correlations of these phenomena among themselves, and with sunspots, solar, eruptions, and terrestrial magnetic disturbances. It also presents comparisons of their trends with the trends of the regular ionization of the ionosphere layers. The dependence of all the phenomena on solar activity is clearly shown.

The prediction of ionosphere characteristics and maximum usable frequencies, by N. Smith and A. S. Taylor. In this paper the authors bring up to date the observations of the year-to-year trends of ionosphere characteristics as related to the sunspot cycle. The day-to-day variations from the monthly averages for the past 2 years are given, and the method of application to future data is indicated. The prediction of monthly average characteristics for undisturbed days is discussed. Tentative predictions of maximum usable frequencies are made for the downgoing half of the sunspot cycle.

SEVENTEENTH ANNUAL CONFERENCE OF STATE UTILITY COMMISSION ENGINEERS

The Seventeenth Annual Conference of State Utility Commission Engineers was held at the Bureau on May 16 to 18, inclusive. Forty-two commission engineers from 26 States, the District of Columbia, and one Province of Canada were in attendance, representing Alabama, Arizona, Arkansas, California, Connecticut, Florida, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Maine, Maryland, Massachusetts, Missouri, New Hampshire, New Jersey, New York, North Carolina, Oklahoma, Pennsylvania, Utah, Washington, West Virginia, Wisconsin, the District of Columbia, and Ontario, Canada. This conference was the most widely representative of any so far held.

The papers presented were as follows: The gas industry in the State of Washington, by Bliss G. Sinclair, assistant chief engineer, Washington; Proposed commission rules relating to metering

of electric service, by F. A. Wolff, National Bureau of Standards, Washington, D. C.; Factors considered in proposing changes in electric service rules, by Geo. P. Steinmetz, chief engineer, Public Service Commission, Wisconsin; The selection of telephone service rate schedules, by Arthur B. Fry, telephone and telegraph engineer, Railroad Commission, California; District telephone service—metropolitan areas, by Wayne E. Limbocker, chief engineer, State Corporation Commission, Kansas; Cost analysis and motor carrier rates, by Homer H. Grant, chief, research and statistical section, Department of Public Service, Washington; Review of the 1938 depreciation report of the special committee on depreciation of the National Association of Railroad and Utility Commissioners, by E. H. Merrill, chief engineer, Public Service Commission, Utah; Comments on the valuation aspect of depreciation, by C. M. Smith, inventory engineer, Public Service Commission, New Hampshire; The engineer's place in the preparation of original cost appraisals or original cost studies, by Earle H. Morris, chief engineer, Public Service Commision, West Virginia; Reproduction new less depreciation compared with the original or investment cost of utility properties, by J. E. Flanders, chief engineer, Department of Public Utilities, Arkansas; Strength of overhead line construction and proposed changes in National Electrical Safety Code, by M. G. Lloyd, National Bureau of Standards, Washington, D. C.

It is regretted that copies of all of the papers presented are not available for distribution to commission engineers not present at the conference. Such copies as may be available must be obtained upon application to the authors of the papers. No copies of the papers are available for distribution by the Secretary.

The conference was arranged by an executive committee of which J. H. Wiley, chief engineer, North Dakota, was chairman. The executive committee for the eighteenth conference, to be held May 14, 15, and 16, 1940, at the National Bureau of Standards, is E. H. Merrill, chief engineer, Public Utilities Commission, Salt Lake City, Utah, chairman; S. B. Nelson, chief engineer, Public Utilities Commission, Jefferson City, Mo., vice chairman; C. M. Smith, Concord, N. H.; C. E. Thornton, Baltimore, Md.; and I. F. McDonnell, Sr., Montgomery, Ala. The secretary of the conference is J. Franklin Meyer, National Bureau of Standards, Washington, D. C.

NEW AND REVISED PUBLICATIONS ISSUED DURING MAY 1939

Journal of Research[3]

Journal of Research of the National Bureau of Standards, volume 22, number 5, May 1939 (RP1200 to RP1208, inclusive). Price 30 cents. Annual subscription, 12 issues, $3.50.

Journal of Research of the National Bureau of Standards, title page, corrections, and contents to volume 21, July to December, 1938 (RP1110 to RP1162, inclusive). Free on application to the Bureau.

Research Papers[3]

[Reprints from February and March 1939 Journal of Research]

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Circulars [3]

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Building Materials and Structures [3]

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During the past month the following publications in this series have been issued:

BMS16. Structural properties of a "Tilecrete" floor construction sponsored by Tilecrete Floors, Inc. Herbert L. Whittemore, Ambrose H. Stang, and Cyrus C. Fishburn. Price 10 cents.

BMS17. Sound insulation of wall and floor constructions. V. L. Chrisler. Price 10 cents.

Technical News Bulletin [3]

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RECENT BUREAU ARTICLES APPEARING IN OUTSIDE PUBLICATIONS [4]

Circulation of ozone in the upper atmosphere. W. W. Coblentz. Bul. Am. Meteorological Soc. (Blue Hill Observatory, Milton, Mass.) **20**, 92 (March 1939).

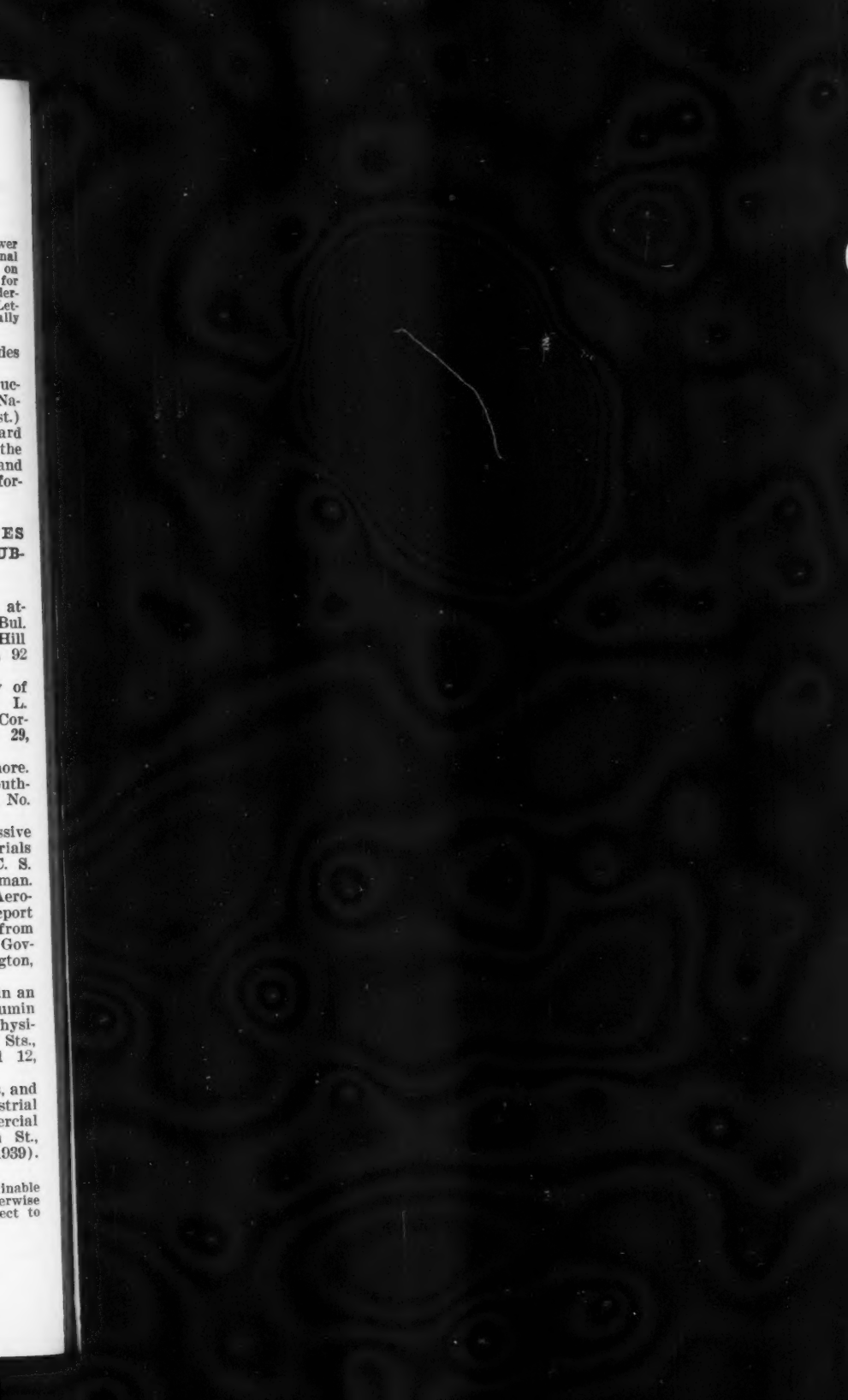
Calculation of luminous efficiency of ionized cesium vapor. Fred L. Mohler. J. Optical Soc. Am. (Cornell University, Ithaca, N. Y.) **29**, 152 (April 1939).

Strain gages. H. L. Whittemore. Baldwin-Southwark (Baldwin-Southwark Corp., Philadelphia, Pa.) **3**, No. 2, 14 (First quarter, 1939).

The "pack" method for compressive tests of thin specimens of materials used in thin-wall structures. C. S. Aitchison and L. B. Tuckerman. Nat. Advisory Committee for Aeronautics (Washington, D. C.) Report 649; April 1939. (Obtainable from Superintendent of Documents, Government Printing Office, Washington, D. C., at 10 cents a copy.)

Determination of quenching rates in an aluminum alloy of the duralumin type. H. L. Logan. Bul. Am. Physical Soc. (Prince and Lemon Sts., Lancaster, Pa.) **14**, 37 (April 12, 1939).

Revised code to protect heads, eyes, and lungs. M. G. Lloyd. Industrial Standardization and Commercial Standards Mo. (29 West 39th St., New York, N. Y.) **10**, 77 (April 1939).

[4] These publications are not obtainable from the Government unless otherwise stated. Requests should be sent direct to the publishers.

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